Exercise 1: AdaBoost - Updates

Suppose you apply AdaBoost on a data set $\mathcal{D}$ consisting of 19 instances $(\mathbf{x}^{(1)}, y^{(1)}), \ldots, (\mathbf{x}^{(19)}, y^{(19)})$. AdaBoost just completed the $(m-1)$-th iteration and the weights for the next iteration are:

$$w^{[m](i)} = 0.01 \quad \text{for } i = 1, \ldots, 10, \quad \text{and} \quad w^{[m](i)} = 0.1 \quad \text{for } i = 11, \ldots, 19.$$

For the beginning of the m-th iteration consider three cases:

(a) $\hat{b}^{[m]}$ is only wrong for $i = 5$ and the rest is correct.

(b) $\hat{b}^{[m]}$ is correct for $i = 11, 12, 13, 14, 19$ and the rest is wrong.

(c) $\hat{b}^{[m]}$ is only correct for $i = 10$ and the rest is wrong.

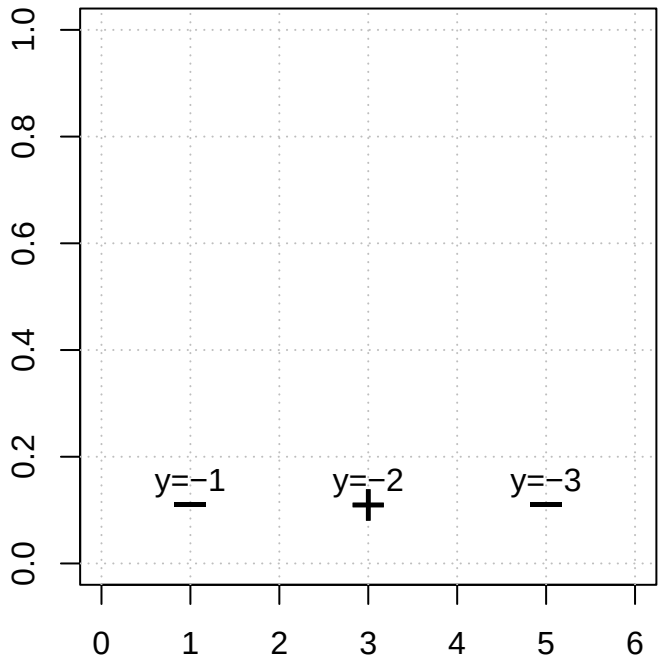
Compute $\text{err}^{[m]}$, $\hat{\beta}^{[m]}$ and the new weights $w^{[m]}$ before the normalizing step for each case. Use the following table:

Case	$\text{err}^{[m]}$	$\hat{\beta}^{[m]}$	$w^{[m+1](i)}$
(a)			
(b)			
(c)			

Hint: You can use that $\sqrt{99} \approx 9.95$ and $99^{-1/2} \approx 0.1$.

Exercise 2: AdaBoost - Decision Stump

Suppose you apply AdaBoost with a decision stump on the data set as in the following figure:



(a) What would be a decision boundary for the first decision stump?

(b) How do the weights of the points change after the first iteration?

(c) How many iterations are at least needed such that AdaBoost's training error is zero?